Architecture and Interfaces for Runway Safety Systems

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Overview

- **Introduction**
- Architecture
- RSS service architecture
- Benefits
- Summary
- Questions

Introduction

- Runway safety systems (RSS) architecture
  - Traditionally tightly integrated
- Evolving system development considerations
  - User needs
  - Life cycle factors
  - COTS resources
  - FAA goals

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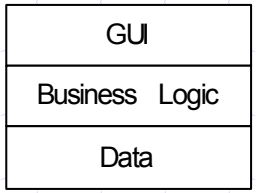
Architecture

- Service view
  - Top down analysis
    - User perspective
  - Use of term service
    - "User service" vs. "interface service"
  - Focus on service dependencies
  - Implementation independent

Layers

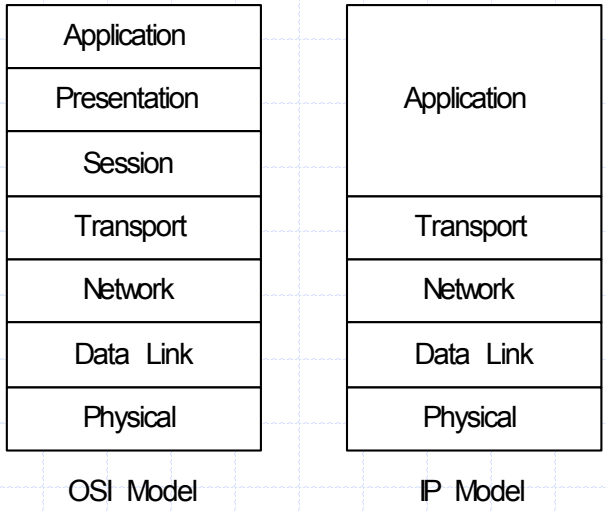
- Layers pattern
  - Supports decomposition into hierarchical layers of abstraction
  - Supports localization of implementation details within each layer
  - Each layer depends on the layer below via the interface between them
- Example: 3-Tier client-server model



- Graphical user interface (GUI) at the top layer can be implemented with web browser and hosted remotely
- Business logic in the middle layer can be modified without affecting lower layer
- Data layer can be implemented with standardized server and database technologies

Layers in Network Architecture

- Example: OSI and IP network architectures



- Different kind of hierarchy: Note that the 3-tier client-server architecture hierarchy is hardware platform independent. The network architecture hierarchy translates to software that is hosted on a single hardware platform.
- The IP network architecture has supported the development of a vast COTS marketplace that has driven down costs of interface development as well as interface software/hardware.

Granularity

- How should the architecture for Runway Safety Systems (RSS) be partitioned?
  - Granularity that is too coarse (too few layers) results in the disadvantages of the monolithic, tightly integrated system
  - Granularity that is too fine (too many layers) results in an excessively complex system
    - Higher development costs
    - Unnecessary processing steps
  - The proper balance will use a minimum number of layers needed to separate functionality that may be shared to support current and future runway safety services.

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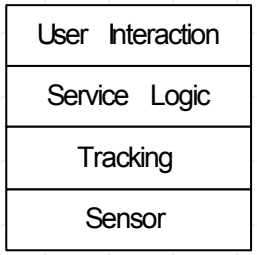
RSS Service Architecture

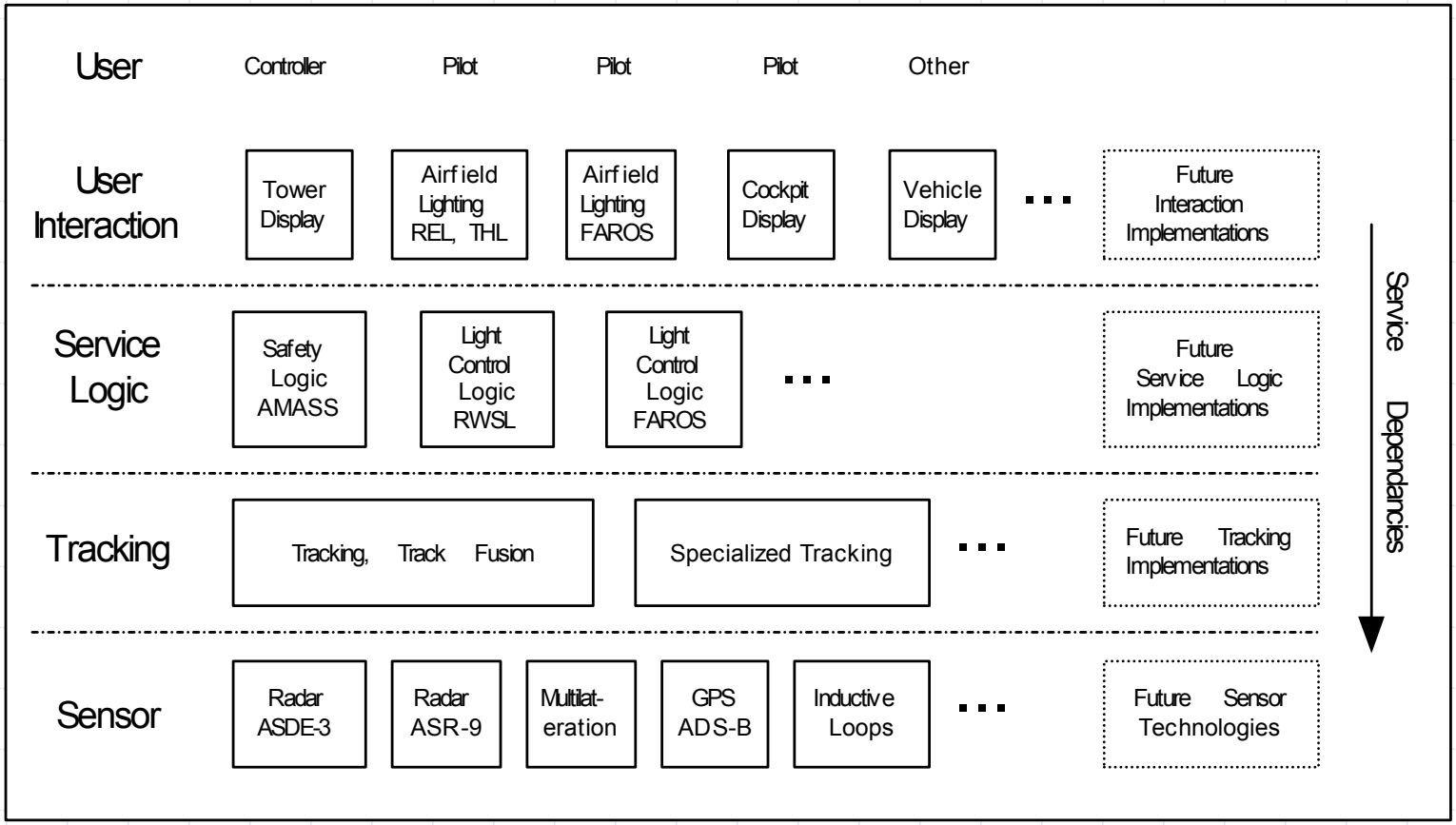


- Propose a hierarchy of four layers
  - Each layer provides services to the layer above it
  - Service definitions include standard data items and requirements for how to use them
  - Interfaces between the layers support the communication needs of one or more services

- User Interaction layer - Services experienced directly by human users of RSS. This layer presents the Service Logic services from below to the user via display mechanisms such as a graphical display or airfield lighting.
- Service Logic layer - Functionality that provides user-service specific logic needed by the User Interaction layer.
- Tracking layer - Includes functionality that provides vehicle track state information for the vehicle movement area of concern. May include multi-sensor fusion and/or specialized track filtering.
- Sensor layer - Includes a broad range of current and future sensor technologies. Provides target information services to the Tracking layer.

RSS Architecture Service Modules

- Possible service modules fit to RSS architecture



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Benefits

- Lowers the cost of future technology refreshes
  - Modules within a service layer can be upgraded individually when needed without forcing changes in other layers.
  - Technology developments that provide opportunity for upgrade of a service module are likely to apply to that module only.
  - Increases competition
    - Different vendors may have strengths in specific technology areas. This architecture allows them to compete for specific service module implementations that fit their specific strengths without having to supply an entire system.

Benefits (2)

- Lowers the cost of adding new user services
  - Over time, an airport may need to add new top-level user services. New user services should reuse lower layer service module implementations when possible.
  - Hypothetical example:
    - Problem: An airport already has an architecturally compliant implementation of a Runway Status Light (RWSL) user service in place for pilots. The airport now wants to add a Final Approach Runway Occupancy Status (FAROS) service as well.
    - Solution: Assuming the existing tracking service module meets the performance requirements of a FAROS service logic module, the problem is reduced to adding implementations for only the two higher layers. The airport can reuse the existing lower level sensor and tracking implementations from the RWSL system stack.

Benefits (3)

- User Interaction layer provides flexibility for the user interface
  - Physical and perceptual constraints limit the number of unique display devices that can be effectively used.
    - Multiple services can be integrated for common display within this layer.
  - Separation of this layer supports future addition of user services to:
    - NAS users beyond the air traffic controllers and pilots at a specific airport
    - Possible future users outside the NAS
- Architecture supports FAA goals and requirements
  - Consistent with FAA-STD-060a- By encouraging definition of standard data items for exchange at each layer for the FAA data registry.
  - Supports goals for data exchange via the FAA's SWIM concept by making standard data items available at each layer.

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- Propose a four layer hierarchy for RSS architecture
  - Interfaces fit at the layer boundaries
  - May package multiple services across the same interface layer
- Standard data items are used in the services
  - Should be defined in the FAA Data Registry
- The service oriented, layered architectural approach proposed for RSS can be compared to the layered architecture of IP networks
  - Both rely on open standards to describe services available at layer boundaries.
  - Perhaps RSS can evolve into more affordable, easily extensible systems the way networks have.

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